Procedures and Guidelines

DIRECTIVE NO. 900-PG-8700.1.1	**APPROVED BY Signature:** *Original Signed By*
EFFECTIVE DATE: April 21, 1999	**NAME:** Vincent V. Salomonson
EXPIRATION DATE: April 21, 2004	**TITLE:** Director of Earth Sciences

Responsible Office: 900 / Earth Sciences Directorate

Title: PROJECT: INSTRUMENT DESIGN, BUILD, TEST and INTEGRATION

P1. PURPOSE

This procedure covers the activities, responsibilities and controls associated with the design, fabrication, test and integration of an instrument to be used in data gathering for science research.

P2. REFERENCES

900-PG-8730.3.1, 900-PG-1310.1.1, 900-8072.1.1
GPG-8700.1, .2, .3 and .4
ISO 9001, Elements 4.4 and 4.11

P3. SCOPE

This procedure applies to instrument based projects undertaken by the Code 900 Directorate. Smaller projects will often omit specific steps that are not required because of the project's size, risk and/or complexity. The Director of Code 900 or his/her Laboratory Chiefs approves this tailoring. This authorization, along with its justification, is documented and a record of this kept with the project file.

This procedure also applies to all civil servants of the Code 900 Directorate who are involved with the project. It also applies to all on-site contractors similarly involved.

P4. DEFINITIONS

PI	Principal Investigator:	Person responsible for the project.
PM	Product Manager:	Person, subordinate to the PI, with major responsibilities within the project.

P5. AUTHORITIES AND RESPONSIBILITIES

Authorities and responsibilities often differ from project to project. Where they do not, they are covered in this procedure. If differing, the particular authorities and responsibilities are documented in the project-specific procedures and handbooks.
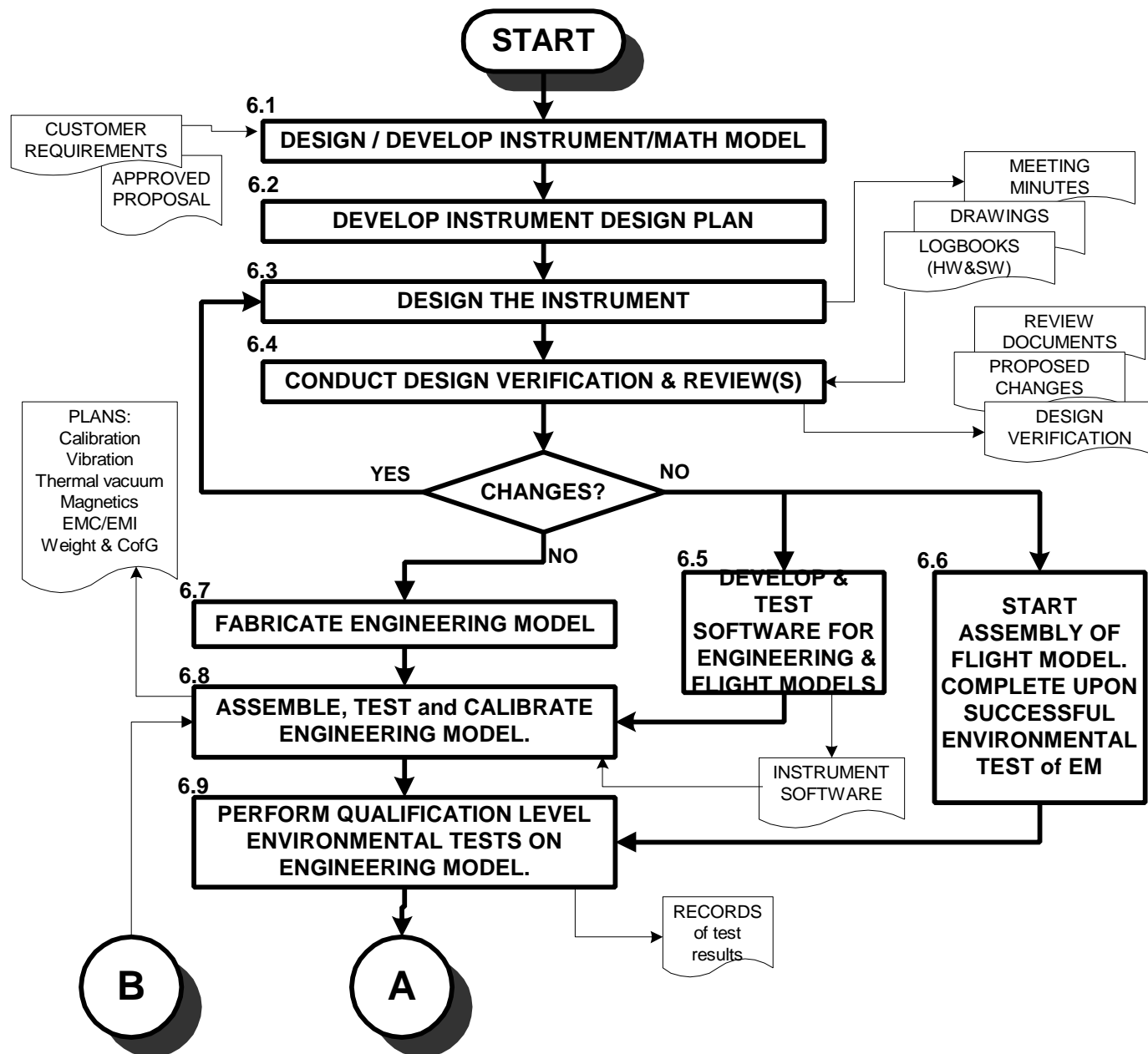
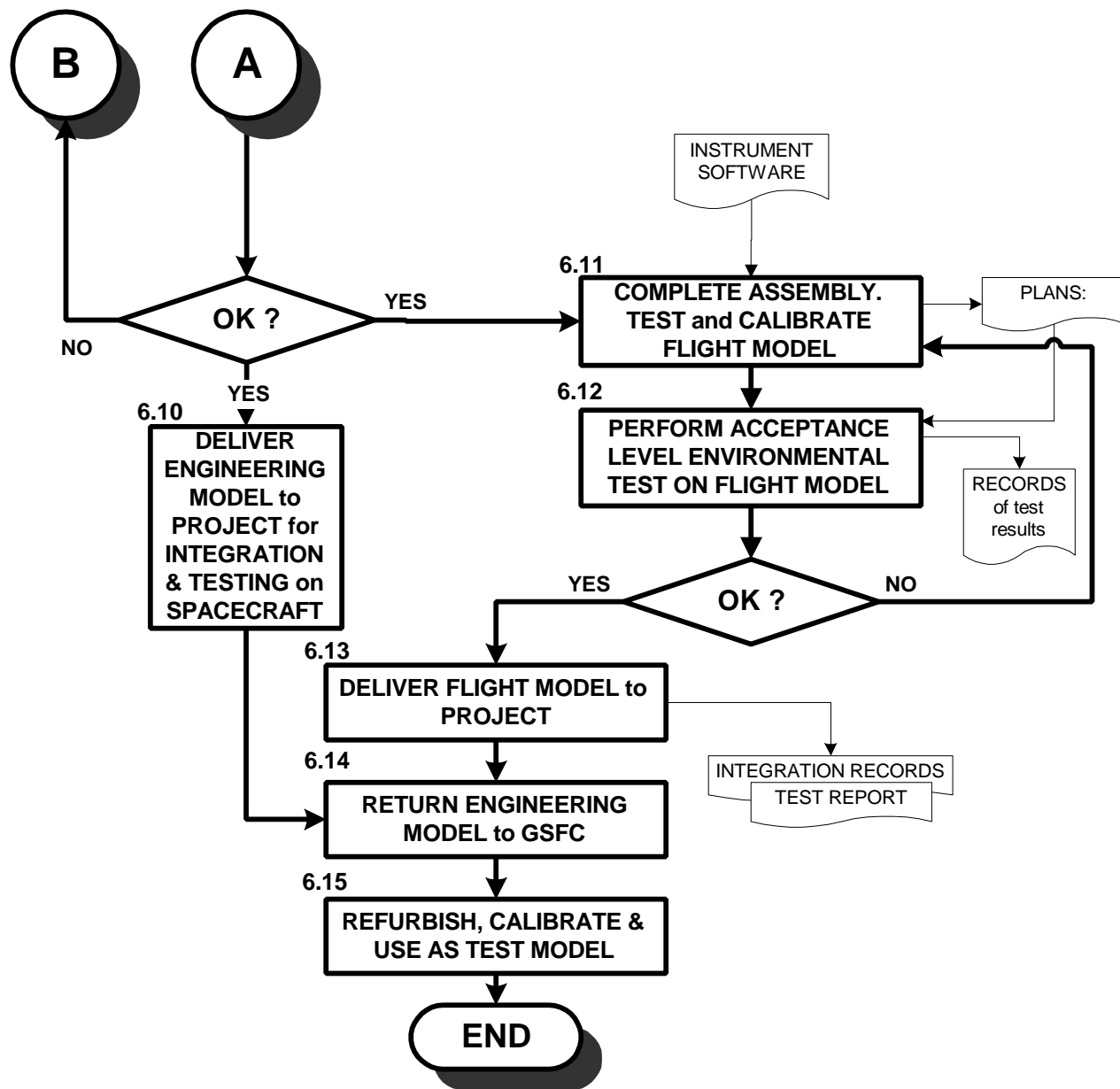|	
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P6. IMPLEMENTATION

NOTE: As projects differ substantially, the sequence of activities may also differ. This PG is structured so that it lists the earliest and/or the latest time an activity may take place.

STEP# RESPONSIBILITY PROCESS STEPS

6.1   PI, PM   Upon project approval and funding, an instrument/math model for the science research is developed and agreed upon. It is to form the base for the instrument design and possible data systems design.

6.2   PI, PM   An overall design plan is developed. The plan is built on the timeline submitted during the proposal stage (900-PG-1310.1.1). It includes the technical interfaces anticipated during the design, development and integration of the instrument. It also includes major milestones, reviews and sign-offs for the project.

6.3   PI, PM   After the design inputs (including the instrument/math model) are gathered, the actual instrument design is performed. The resulting Drawings, Bill of Materials, Test Plans, Meeting Minutes and Logs are used in the following verification and review activities.

6.4   PI, PM   Design verification is conducted and a PDR conducted. If design changes are required, the process returns to step # 6.3 followed by re-verification and a follow up PDR as required.
With the design approved, three steps start simultaneously (6.5, 6.6 and 6.7).

6.5   PI, PM   Instrumentation software is developed, tested and readied for inclusion when the Engineering Model is completed. Test results are documented.

6.6   PI, PM   The building and assembly of the Flight Model is started. It is not completed until the Engineering Model has passed its qualification level environmental tests.

6.7   PI, PM   Starting concurrently with step #'s 6.5 and 6.6, the Engineering Model is being built to the design approved after the PDR.

6.8   PI, PM   The Engineering model is assembled. With the instrumentation software developed and tested in 6.5, the Engineering Model is tested and calibrated.

6.9   PI, PM

Qualification level environmental tests are performed on the Engineering Model along with a CDR. If not approved, one of several paths could be taken. At one extreme, the process could return to the design step for a design change and subsequent verification, build and test (steps 6.3 through 6.9) or, at the other extreme need only minor adjustments performed in step 6.8. Where the design is involved, any changes are implemented on the Flight Model, which is being built and assembled in step 6.6.

Upon a favorable conclusion of step 6.9, the process continues simultaneously with steps 6.10 and 6.11.

6.10   PI, PM

The approved Engineering Model is delivered to the project for inclusion in integration and testing on the spacecraft.

6.11   PI, PM

Assembly work on the Flight Model proceeds to conclusion. With the instrument software from step 6.5, the Flight Model is tested and calibrated.

6.12   PI, PM

Acceptance level environmental tests are performed on the Flight Model. With the design and Engineering Model tested and approved, any test failure for the Flight Model is analyzed and resolved in the assembly step # 6.11.

6.13   PI, PM

The approved Flight Model is delivered to the project. The project replaces the Engineering Model with the Flight Model for the remainder of the spacecraft testing.

6.14   PI, PM

The Engineering Model is returned to GSFC.

6.15   PI, PM

The Engineering Model is refurbished, re-calibrated and rendered available as a test model.

The process continues with the operation of the Flight Instrument, its data output, data analysis/testing and sharing with the science team, the scientific community and, if appropriate, the general public in 900-PG-8072.1.1

START

6.1 DESIGN / DEVELOP INSTRUMENT/MATH MODEL

CUSTOMER REQUIREMENTS

APPROVED PROPOSAL

6.2 DEVELOP INSTRUMENT DESIGN PLAN

MEETING MINUTES

DRAWINGS

LOGBOOKS (HW&SW)

6.3 DESIGN THE INSTRUMENT

6.4 CONDUCT DESIGN VERIFICATION & REVIEW(S)

REVIEW DOCUMENTS

PROPOSED CHANGES

DESIGN VERIFICATION

PLANS:
Calibration
Vibration
Thermal vacuum
Magnetics
EMC/EMI
Weight & CofG

CHANGES?   YES   NO

NO

6.5 DEVELOP & TEST SOFTWARE FOR ENGINEERING & FLIGHT MODELS

6.6 START ASSEMBLY OF FLIGHT MODEL. COMPLETE UPON SUCCESSFUL ENVIRONMENTAL TEST of EM

6.7 FABRICATE ENGINEERING MODEL

6.8 ASSEMBLE, TEST and CALIBRATE ENGINEERING MODEL.

INSTRUMENT SOFTWARE

6.9 PERFORM QUALIFICATION LEVEL ENVIRONMENTAL TESTS ON ENGINEERING MODEL.

RECORDS of test results

B

A

B

A

INSTRUMENT
SOFTWARE

6.11
COMPLETE ASSEMBLY.
TEST and CALIBRATE
FLIGHT MODEL

PLANS:

OK ?   YES

NO

YES

6.10
DELIVER
ENGINEERING
MODEL to
PROJECT for
INTEGRATION
& TESTING on
SPACECRAFT

6.12
PERFORM ACCEPTANCE
LEVEL ENVIRONMENTAL
TEST ON FLIGHT MODEL

RECORDS
of test
results

YES   **OK ?**   NO

6.13
DELIVER FLIGHT MODEL to
PROJECT

6.14
RETURN ENGINEERING
MODEL to GSFC

INTEGRATION RECORDS
TEST REPORT

6.15
REFURBISH, CALIBRATE &
USE AS TEST MODEL

END

P7. RECORDS

Smaller projects will often omit specific steps, and their associated records, which are not required because of the project's size, risk and/or complexity. The Director of Code 900 or his/her Laboratory Chiefs approves this tailoring. This authorization, along with its justification, is documented and a record of this kept with the project file. Thus, not all of the records listed here exist in every project:

- Instrumentation software test results.
- Customer requirements (if available)
- Design drawings
- Work Order Authorization (WOA)
- HW and/or SW log books
- Review meeting minutes including action items
- Design verification
- Calibration records (for both Engineering and Flight Models)
- Vibration test records (for both Engineering and Flight Models)
- Thermal vacuum test records (for both Engineering and Flight Models)
- Magnetics test records (for both Engineering and Flight Models)
- EMC/EMI records (for both Engineering and Flight Models)
- Weight and Center of Gravity records (for both Engineering and Flight Models)
- Integration records
- Final test report

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	04/21/99	Original PG, written to augment GPG-8700.1, .2, .3,and .4, by providing more 900-specific activities, records and controls.